

## CLAIMS

1. A non-volatile memory comprising:

an insulating substrate having a plurality of first electrodes  
extending therethrough from a front surface of the substrate  
5 to a rear surface thereof,

a second electrode formed on one surface side of the substrate,  
and

a recording layer held between the first electrodes and the  
second electrode and variable in resistance value by electric  
10 pulses applied across the first electrodes and the second  
electrode,

the plurality of first electrodes being electrically  
connected to the recording layer in a region constituting a  
single memory cell.

15 2. The non-volatile memory according to claim 1 wherein  
the first electrodes are filled respectively in a plurality  
of fine pores formed in the insulating substrate, the fine  
pores being formed by irradiating the substrate with a beam  
of ion or neutron high-energy particles perpendicular to the  
20 front surface thereof to produce defects in the substrate,  
and selectively etching the defects produced.

3. The non-volatile memory according to claim 1 wherein  
the second electrodes are provided in the form of stripes,  
and third electrodes are provided in the form of stripes on  
25 the other surface side of the insulating substrate and extend  
orthogonal to the second electrodes when seen from above, each  
of the third electrodes being electrically connected to at  
least some of the first electrodes, the second electrodes and

the third electrodes forming laps when seen from above to provide memory cells in the respective regions of the laps.

4. The non-volatile memory according to claim 1 wherein the recording layer comprises a phase-change material having  
5 at least two stable phases different in resistance value and capable of being reversibly switched between the phases.

5. The non-volatile memory according to claim 4 wherein the phase-change material contains a chalcogenide material.

6. The non-volatile memory according to claim 1 wherein  
10 the first electrodes are randomly arranged relative to the insulating substrate.

7. The non-volatile memory according to claim 1 wherein the memory cells are different in the number of first electrodes contained therein.

15 8. The non-volatile memory according to claim 7 wherein each of the memory cells contains  $0.5 \times 10^1$  to  $4 \times 10^3$  first electrodes on the average.

9. The non-volatile memory according to claim 1 wherein each of the first electrodes has a diameter of 5 to 500 nm.

20 10. The non-volatile memory according to claim 1 wherein assuming that S1 is the total area of contact of the portions of the intermediate electrodes contained in the optional memory cell with the recording layer and that S2 is the area of the recording layer contained in the optional cell, S1/S2 is in  
25 the range of  $10^{-4}$  to  $10^{-1}$ .

11. The non-volatile memory according to claim 1 wherein the recording layer comprises Ge-Sb-Te, and each of the first electrodes comprises at least one of rhodium (Rh), platinum

(Pt), palladium (Pd), nickel (Ni), cobalt (Co), chromium (Cr), rhenium (Re), iridium (Ir) and gold (Au).

12. The non-volatile memory according to claim 1 wherein the insulating substrate is a polycarbonate substrate.

5        13. A paper display comprising the non-volatile memory according to claim 1.